



# Geophysical Methods for Site Characterization and Measurement of In Situ Properties

**W.U. 33014**

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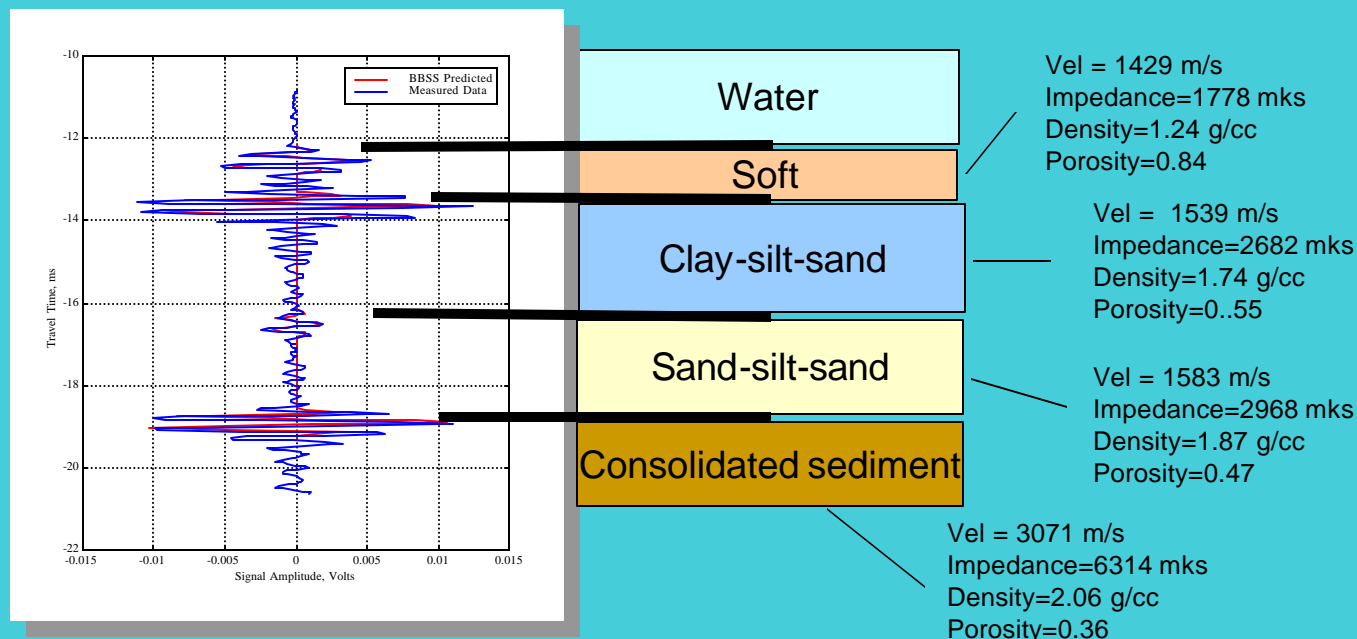
# Problem

- When to Remediate
  - Devise seismic procedures to predict liquefaction potential
  - Current site evaluation methods have severe limitations
- Remediation Effectiveness
  - Evaluate using before and after seismic procedures
  - Quantify improvements in terms of engineering parameters related to liquefaction potential



# Objective (as stated in 1992)

- To develop a seismic / acoustic impedance procedure to identify (by material type) and characterize (by density, porosity, shear strength, etc.) large volumes of soil materials in terms related to their susceptibility for liquefaction when subjected to earthquakes



## Approach Rationale

- Broad areal site coverage more representative of true site conditions than discrete data points obtained through borings or push probes
- Entire seismic wave train affected by numerous definable site parameters
- Relationship between seismic wave train modification and earthquake susceptibility can be established
- Application of Biot theory will provide more accurate and economical site characterization

# Accomplishments

## FY 95

- Conducted workshop on objectives and test sites
- Selected test sites

## FY 96

- Documented workshop proceedings
- Completed first series of field tests
- Assessed applicability of Biot theory

# Accomplishments (Continued)

## FY 97

- Completed seismic impedance / crosshole tomography capability integration
- Completed second and third series of field tests

## FY 98

- Correlated seismic wave velocities and other factors to liquefaction potential indicators
- Correlated seismic wave attenuation and full waveform modification indicators to liquefaction potential (Biot theory)

# Accomplishments (Continued)

## FY 99

- Improved and "fine-tuned" field procedures
- Abbreviated report on field procedures
- Completed analytical and data processing procedures
- Conducted first upstream site characterization field test

# Accomplishments (Continued)

## FY 00

- Completed report, “Field Procedures for Acquisition of Liquefaction-Relevant Seismic Data”
- Completed modification of velocity and density inversion algorithms
- Completed inversion extraction of velocity and density profiles from surface-to-borehole measurements at Salmon Lake and Conconully Reservoir
- Published report on waterborne survey of Arkabutla Reservoir

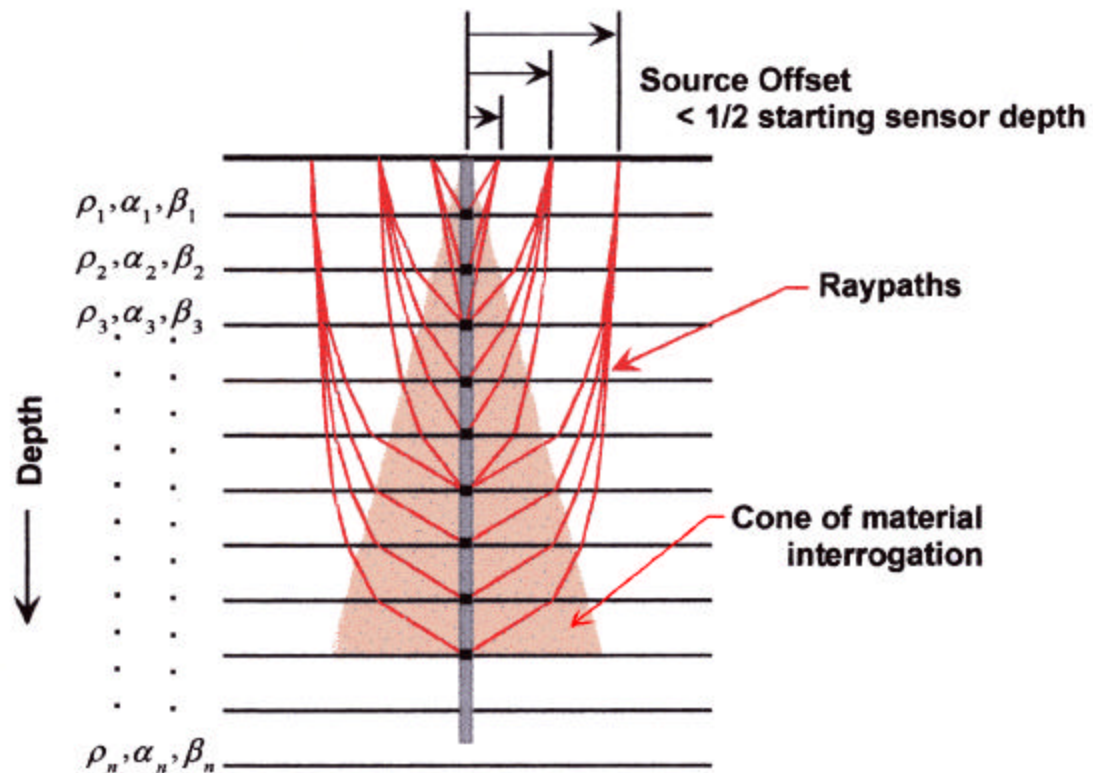


# Accomplishments (Concluded)

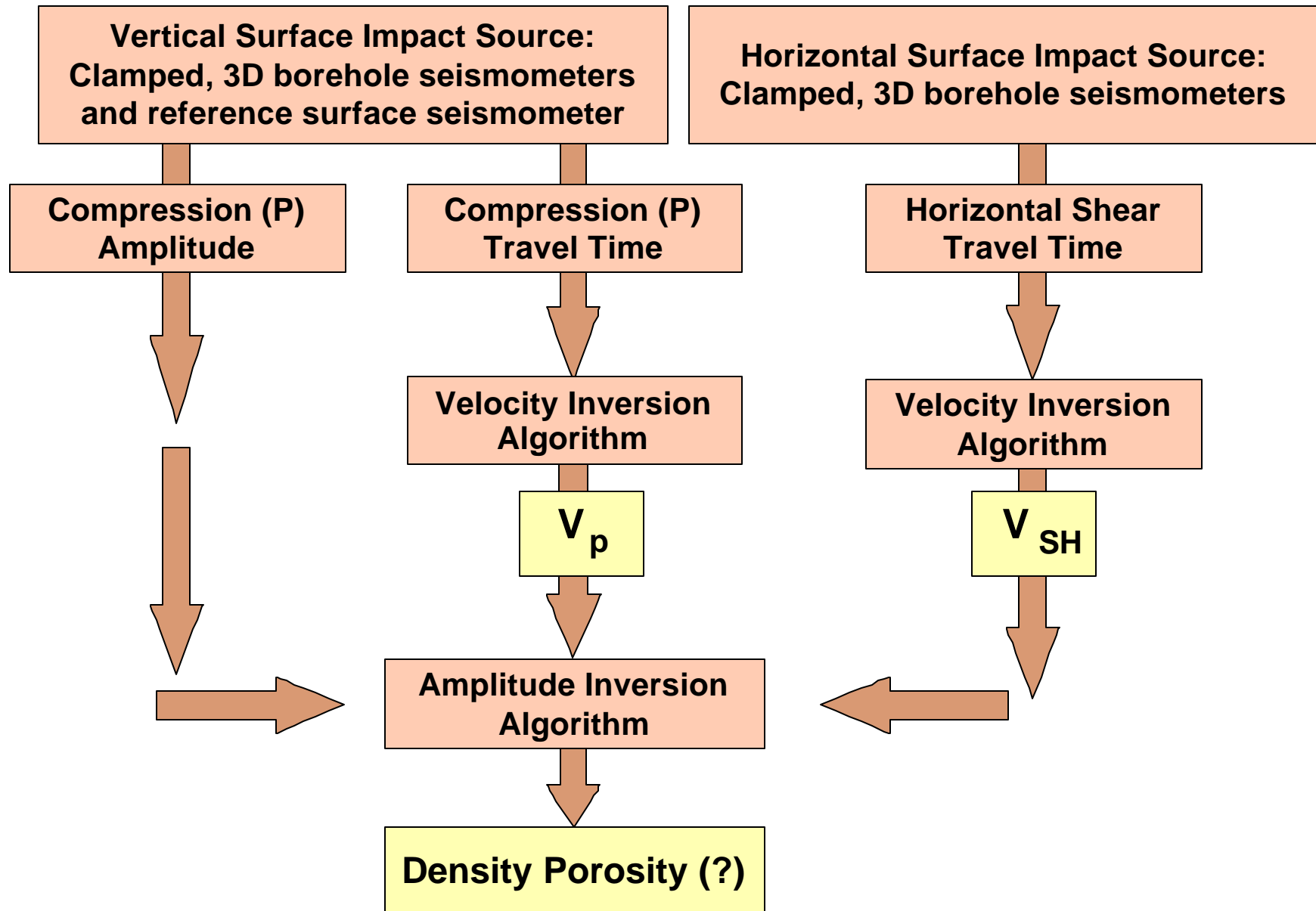
## FY 01

- Conducted final series of downstream verification field tests (Sikeston, Missouri)
- Finalize user-friendly, graphics-based CD of parameter inversion processing for tech transfer
- Publish final reports

## Acquisition Geometry and Conceptual Model



# Data Acquisition / Inversion



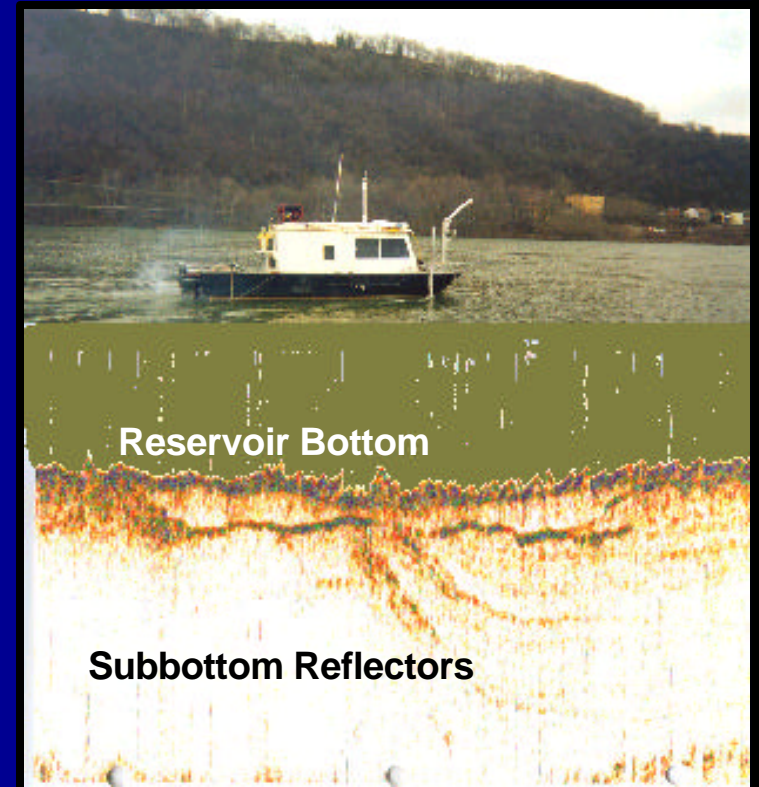
# Geophysical Methods for Site Characterization and Measurement of In Situ Properties

## Products

- New geophysical to geotechnical parameter correlations
- New or adapted geophysical methods and field procedures for upstream and downstream applications
- New geophysical data processing procedures
- Efficient, cost-effective procedure for assessing in situ liquefaction potential of soils
- Documentation in concise Technical Reports and user-friendly CD

## Tasks remaining

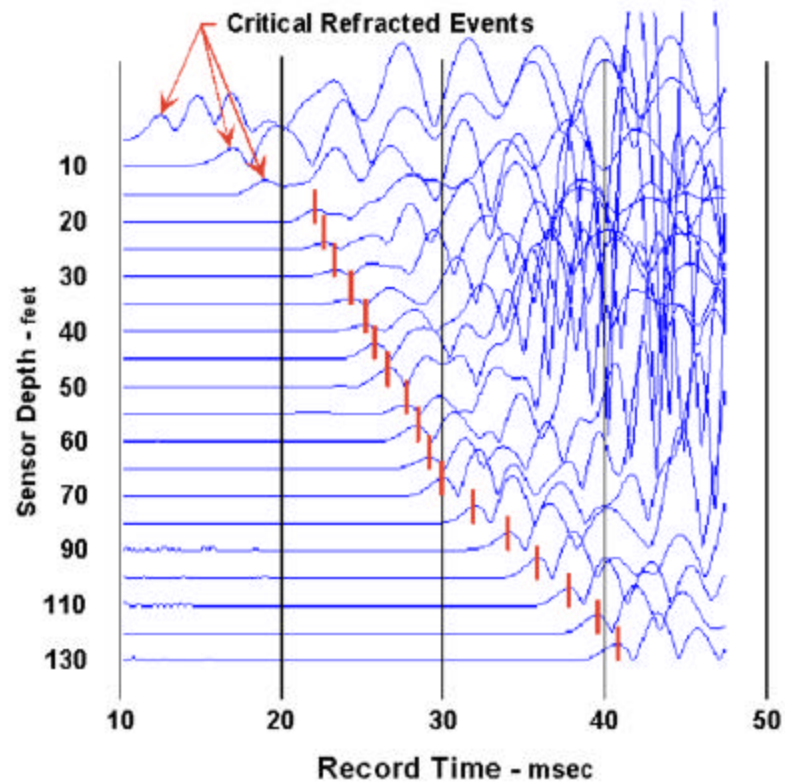
- Use well documented test site (Grenada Lake) to validate upstream procedures
- Publish final report on upstream data acquisition, processing, and validation



## Amplitude Data for Density Inversion

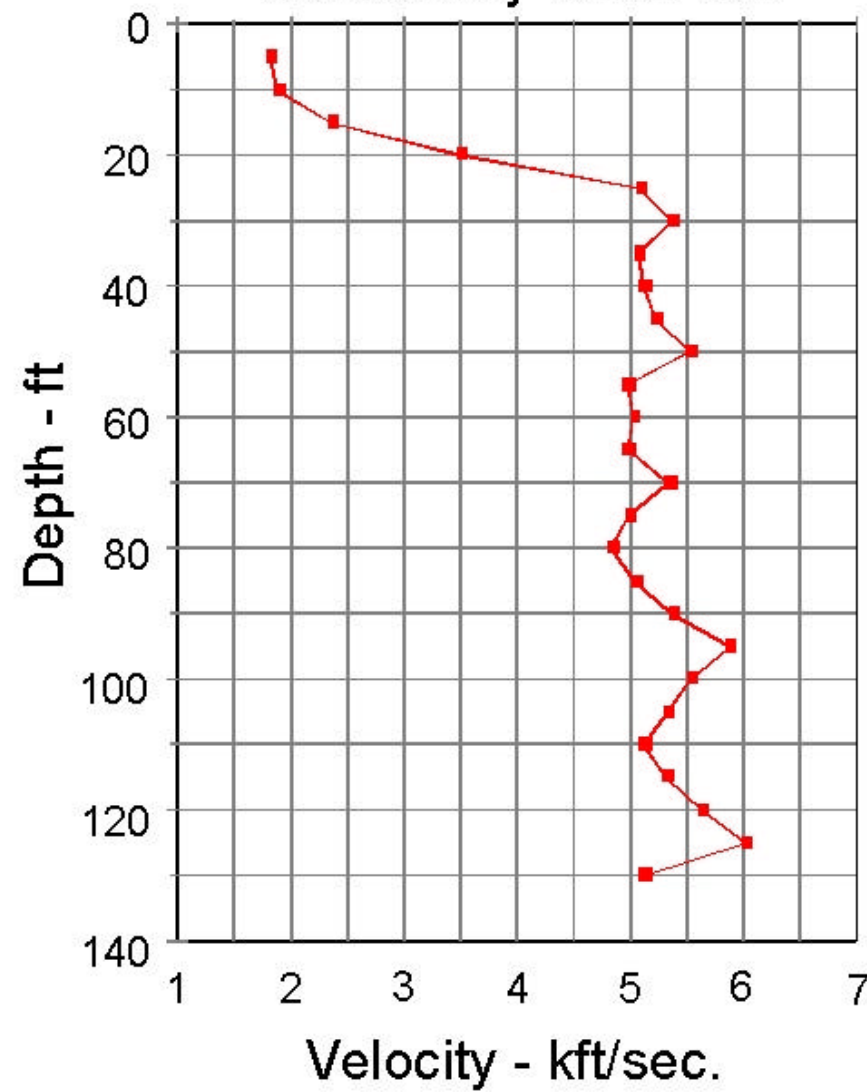
### Normalized Absolute Value Amplitude Plot

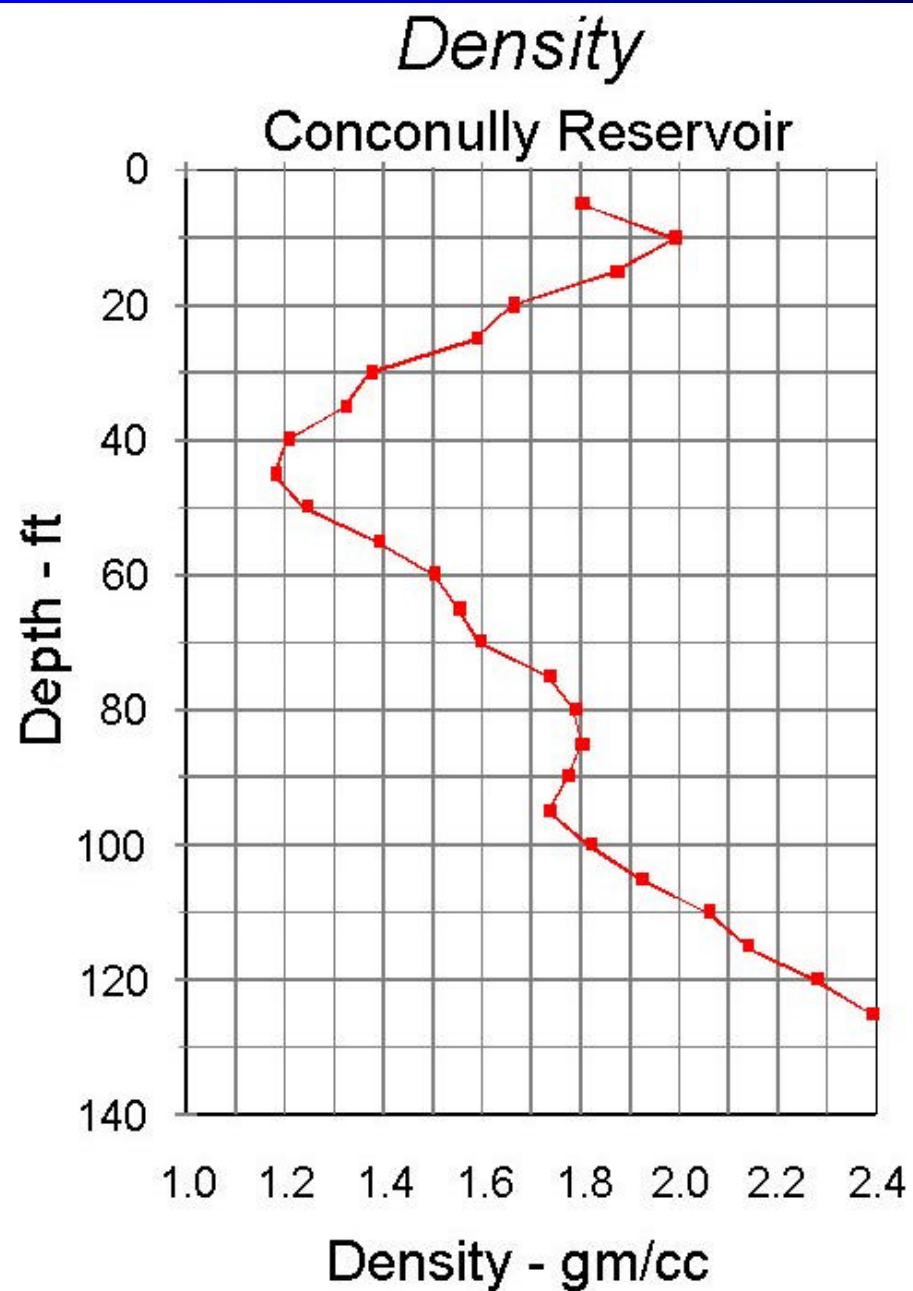
Source Offset = 8.72 feet



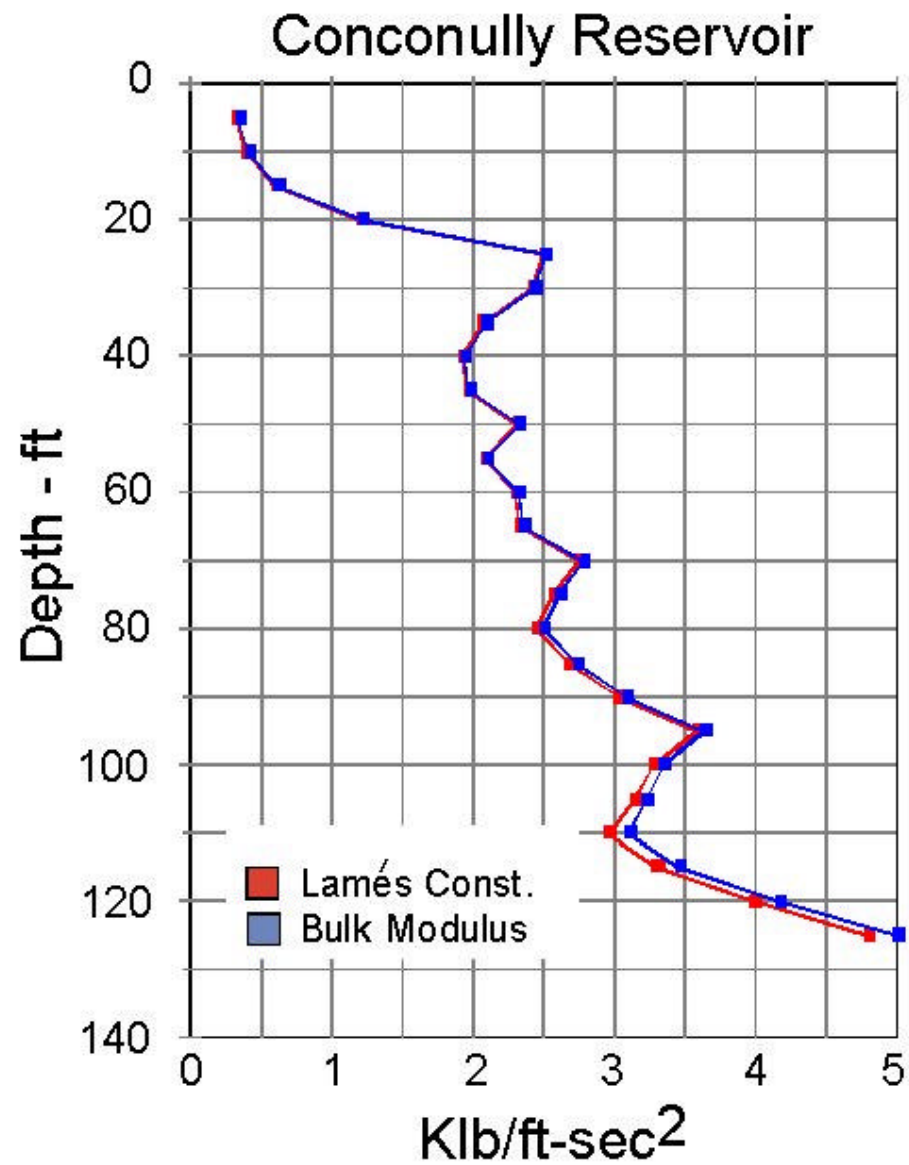
# *Compression Velocity*

## Conconully Reservoir





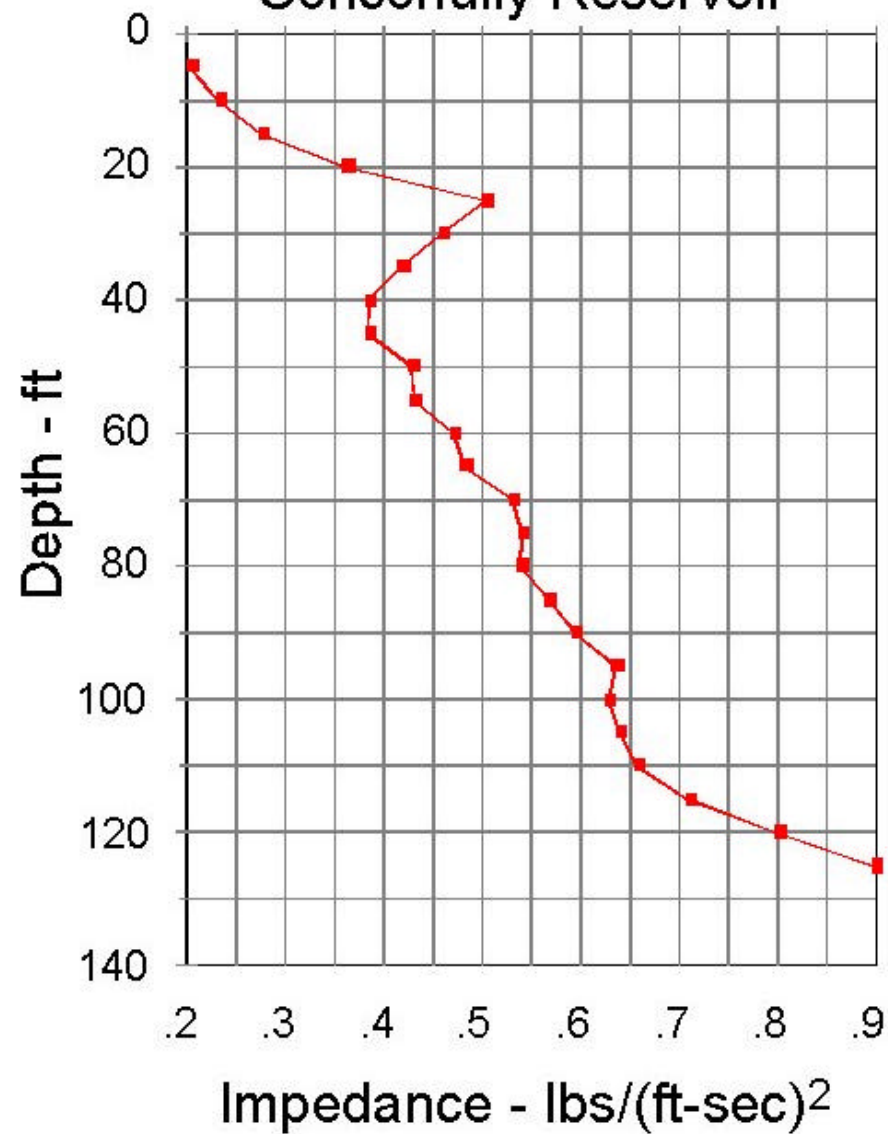
## *Bulk Modulus & Lamé's Constant*





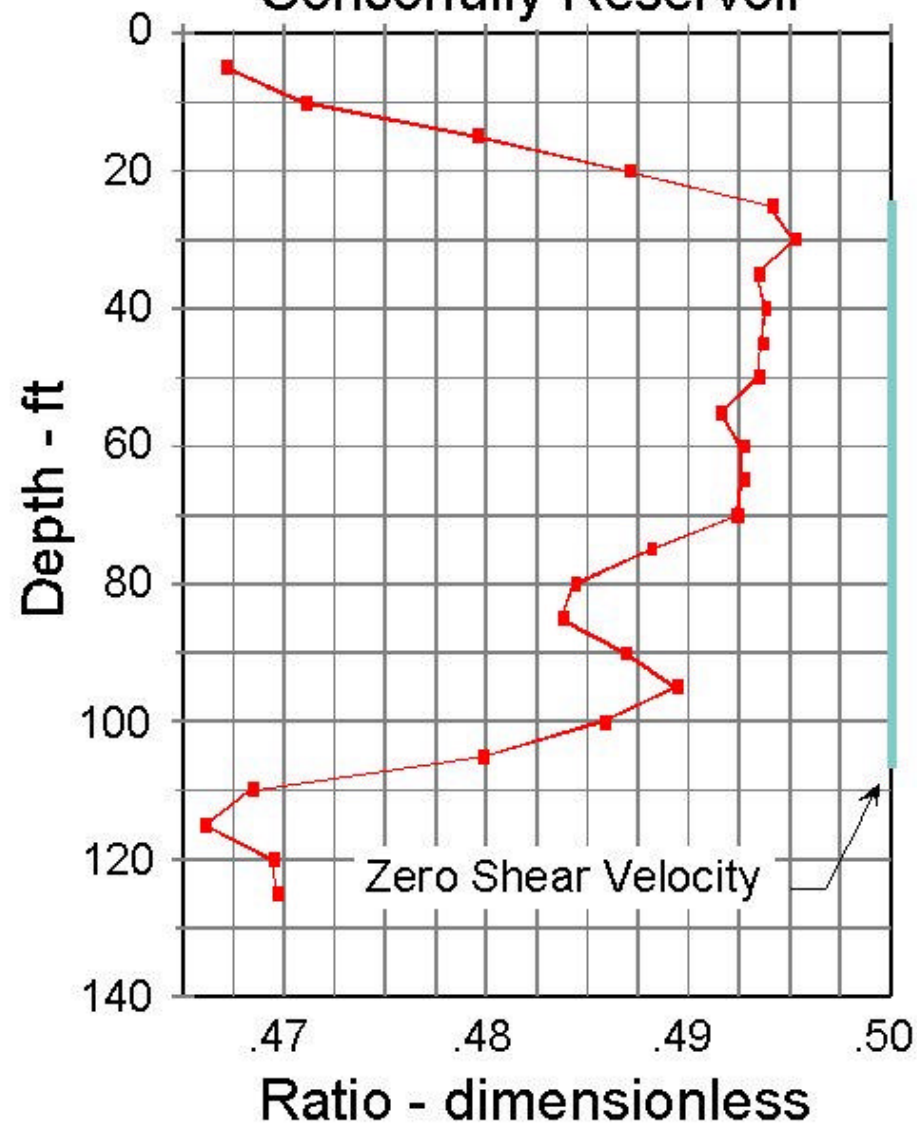
# *Compression Impedance*

## Conconully Reservoir



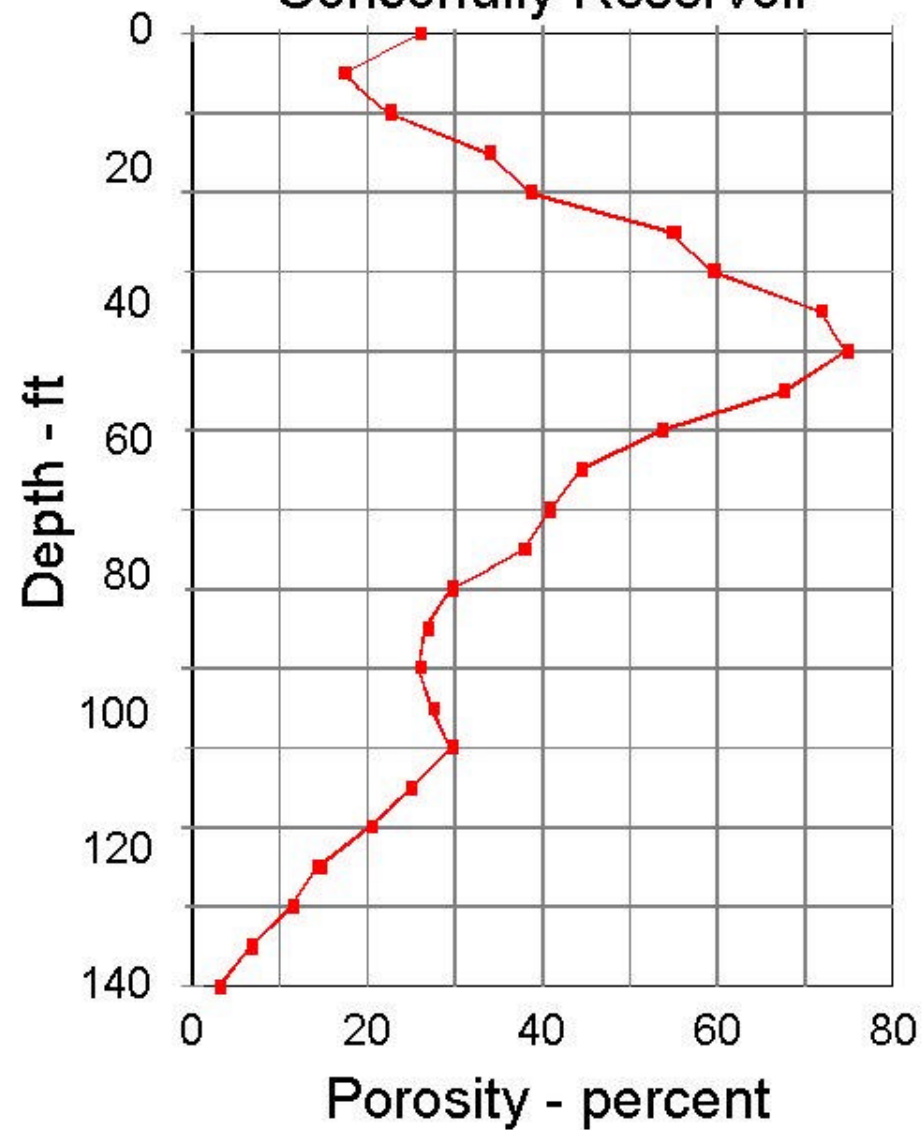
# *Poisson's Ratio*

## Conconully Reservoir



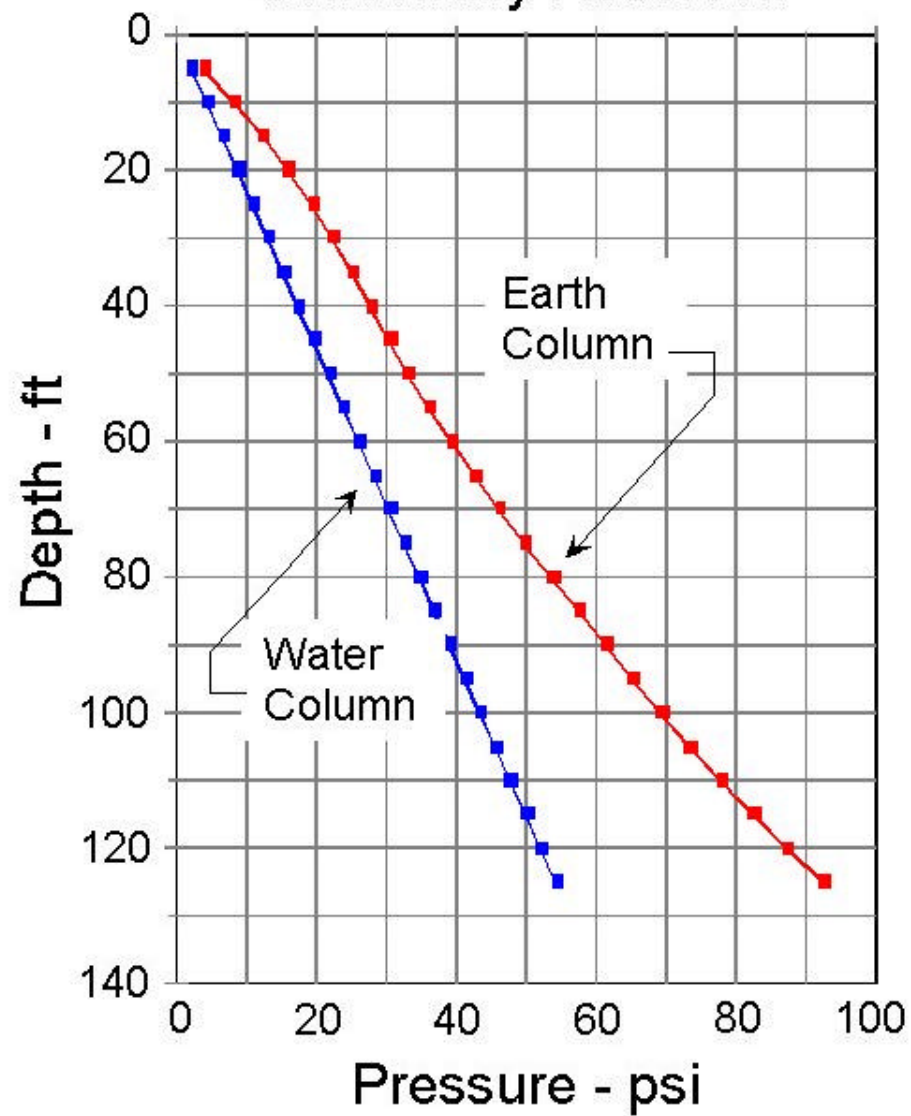
# Porosity

## Conconully Reservoir



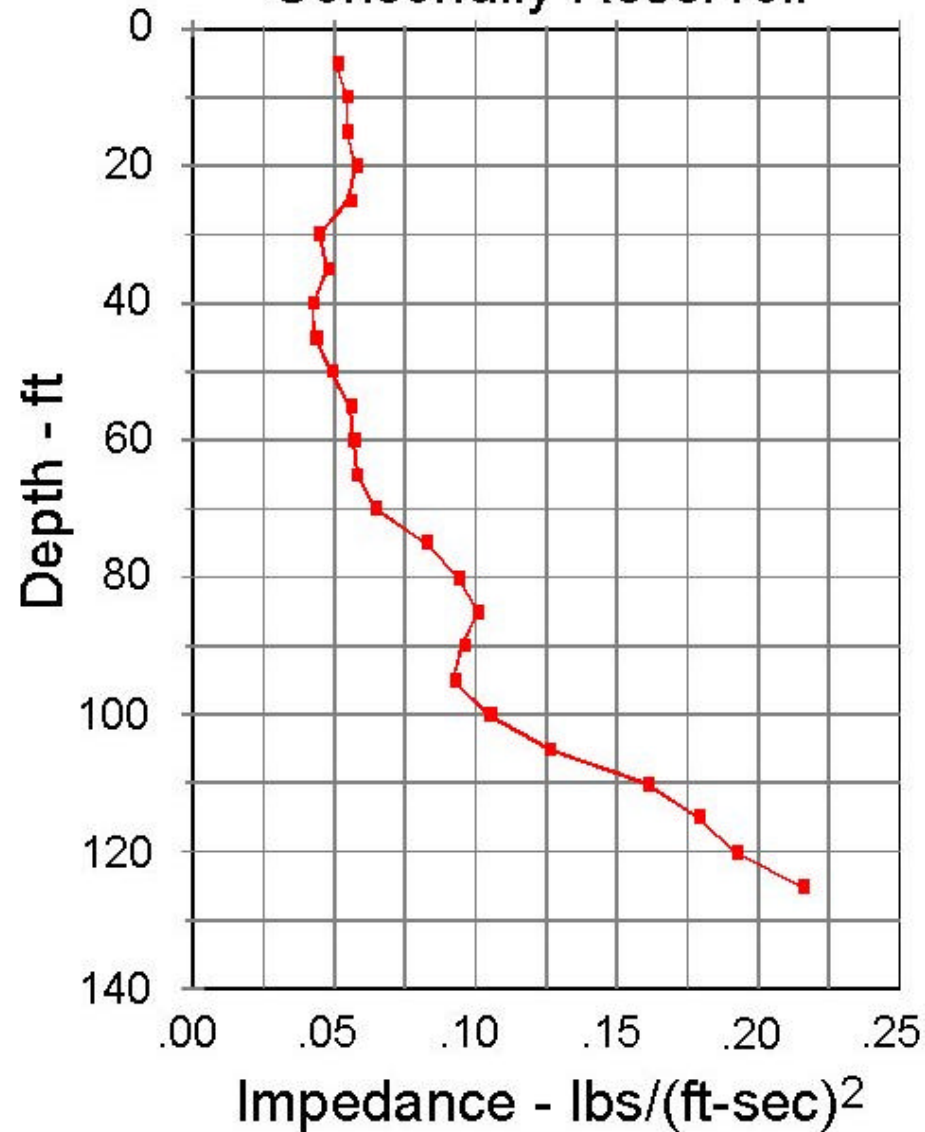
# Overburden Pressure

## Conconully Reservoir



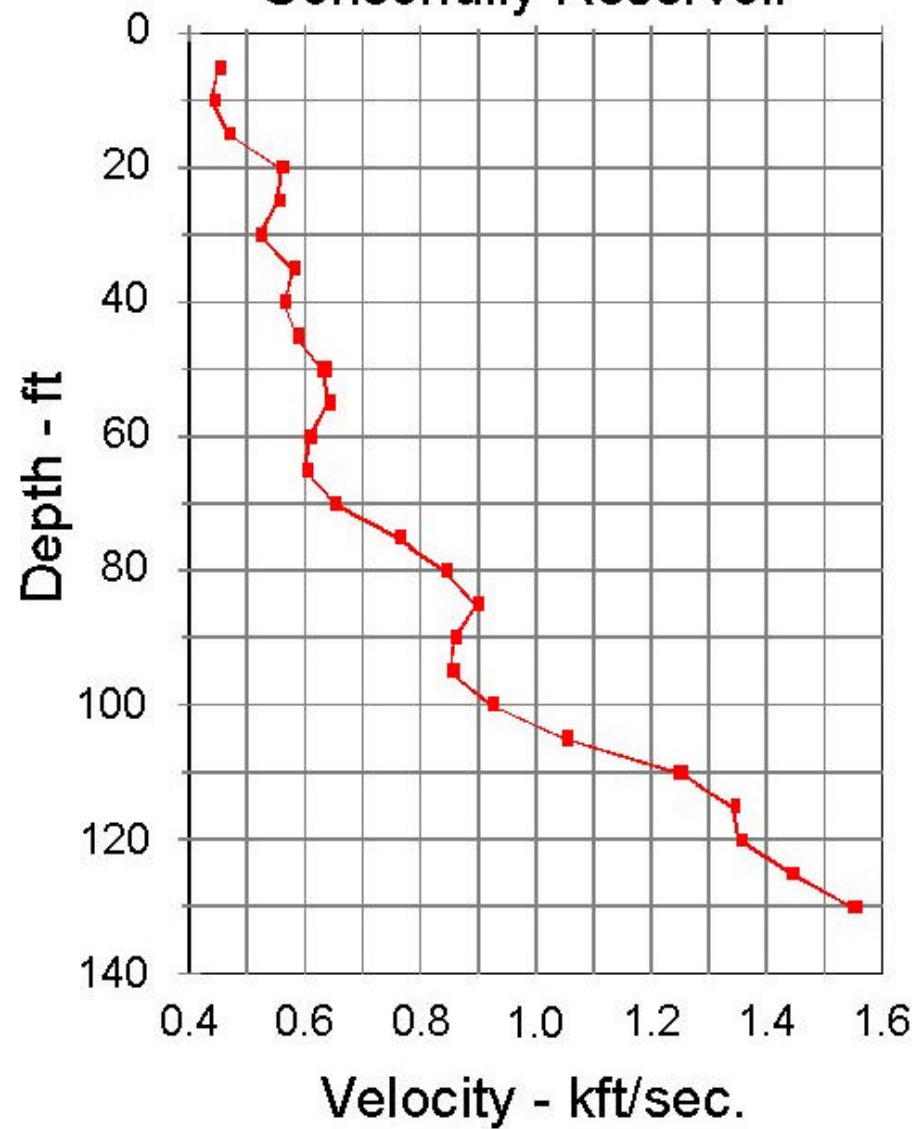
## *Shear Impedance*

### Conconully Reservoir



# *Shear Velocity*

## Conconully Reservoir



## *Inversion Velocity vs Fluid Velocity*

